

# PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

# PCT

To:

OKADO, Akiyoshi  
Nagoya Center Bldg., Annex 2nd Fl.  
2-22-2 Nishiki, Naka-ku  
Nagoya-shi, Aichi 460-0003  
JAPAN

NOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL SEARCH REPORT AND  
THE WRITTEN OPINION OF THE INTERNATIONAL  
SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

<p>Date of mailing (day/month/year) <span style="float: right;">17/06/2005</span></p>	
<p>Applicant's or agent's file reference TJ0404-PCT</p>	<p><b>FOR FURTHER ACTION</b>      See paragraphs 1 and 4 below</p>
<p>International application No. PCT/JP2004/015179</p>	<p>International filing date (day/month/year) <span style="float: right;">06/10/2004</span></p>
<p>Applicant  TOYOTA JIDOSHA KABUSHIKI KAISHA</p>	

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

**Filing of amendments and statement under Article 19:**

The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

**When?** The time limit for filing such amendments is normally 2 months from the date of transmittal of the International Search Report; however, for more details, see the notes on the accompanying sheet.

**Where?** Directly to the International Bureau of WIPO, 34 chemin des Colombettes  
1211 Geneva 20, Switzerland, Facsimile No.: (41-22) 740.14.35

**For more detailed instructions,** see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.
3. ☐ **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:
- ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.
- ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

**4. Reminders**

Shortly after the expiration of **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90bis.1 and 90bis.3, respectively, before the completion of the technical preparations for international publication.

The applicant may submit comments on an informal basis on the written opinion of the International Searching Authority to the International Bureau. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established. These comments would also be made available to the public but not before the expiration of 30 months from the priority date.

Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until **30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices.

In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months.

See the Annex to Form PCT/IB/301 and, for details about the applicable time limits, Office by Office, see the *PCT Applicant's Guide*, Volume II, National Chapters and the WIPO Internet site.

<p>Name and mailing address of the International Searching Authority</p> <div style="display: flex; align-items: center;"> <div> <p>European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016</p> </div> </div>	<p>Authorized officer</p> <p style="text-align: center; font-size: 1.2em;">Katrin Sommermeyer</p>
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## NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the PCT Applicant's Guide, a publication of WIPO.

In these Notes, "Article", "Rule", and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions respectively.

### INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only.

#### What parts of the International application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

#### When?

Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

#### Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

#### How?

Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

#### What documents must/may accompany the amendments?

##### Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.

## NOTES TO FORM PCT/ISA/220 (continued)

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped), whether

- (i) the claim is unchanged;
- (ii) the claim is cancelled;
- (iii) the claim is new;
- (iv) the claim replaces one or more claims as filed;
- (v) the claim is the result of the division of a claim as filed.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:  
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."
2. [Where originally there were 15 claims and after amendment of all claims there are 11]:  
"Claims 1 to 15 replaced by amended claims 1 to 11."
3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:  
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or  
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."
4. [Where various kinds of amendments are made]:  
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

### "Statement under article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

It must be in the language in which the international application is to be published.

It must be brief, not exceeding 500 words if in English or if translated into English.

It should not be confused with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It may not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

### Consequence if a demand for international preliminary examination has already been filed

If, at the time of filing any amendments under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the same time of filing the amendments with the International Bureau, also file a copy of such amendments with the International Preliminary Examining Authority (see Rule 62.2(a), first sentence).

### Consequence with regard to translation of the international application for entry into the national phase

The applicant's attention is drawn to the fact that, where upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.

Rest Available Copy

## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference TJ0404-PCT	<b>FOR FURTHER ACTION</b> see Form PCT/ISA/220 as well as, where applicable, item 5 below.	
International application No. PCT/JP2004/015179	International filing date (day/month/year) 06/10/2004	(Earliest) Priority Date (day/month/year) 08/10/2003
Applicant  TOYOTA JIDOSHA KABUSHIKI KAISHA		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 4 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ The international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (See Box II).

3. ☐ **Unity of invention is lacking** (see Box III).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☐ the text is approved as submitted by the applicant.

☒ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the **drawings**,

a. the figure of the **drawings** to be published with the abstract is Figure No. 13

☒ as suggested by the applicant.

☐ as selected by this Authority, because the applicant failed to suggest a figure.

☐ as selected by this Authority, because this figure better characterizes the invention.

b. ☐ none of the figures is to be published with the abstract.

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2004/015179

## Box No. IV Text of the abstract (Continuation of item 5 of the first sheet)

The invention is intended to present an insulated gate type semiconductor device that can be manufactured easily and its manufacturing method while realizing both higher withstand voltage design and lower on-resistance design. The semiconductor device comprises N+ source region 31, N+ drain region 11, P- body region 41, and N- drift region 12. By excavating part of the upper side of the semiconductor device, a gate trench 21 is formed. The gate trench 21 incorporates the gate electrode 22. A P floating region 51 is provided beneath the gate trench 21. A further trench 35 differing in depth from the gate trench 21 may be formed, a P floating region 54 being provided beneath the trench 25.



## INTERNATIONAL SEARCH REPORT

International Application No

PCT/JP2004/015179

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H01L29/78 H01L29/739 H01L29/06 H01L29/423 H01L21/336  
H01L21/331

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, INSPEC, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 194 741 B1 (KINZER D M ET AL) 27 February 2001 (2001-02-27)	1,11
Y	column 4, line 49 - line 60; figure 6	3-6, 8-10,13
A	column 2, line 36 - column 3, line 50; figures 1,2	6
Y	----- WO 00/70654 A (INFINEON TECHNOLOGIES AG ET AL) 23 November 2000 (2000-11-23)	3-6,8,9, 13
A	page 7, line 7 - line 18; figure 3	1,11
Y	----- WO 99/52152 A (HITACHI LTD ET AL) 14 October 1999 (1999-10-14)	10
A	figure 4	1,6
A	----- US 2003/160281 A1 (CHEN X) 28 August 2003 (2003-08-28) paragraph '0025! - paragraph '0036!; figures 2A-2C,3A-3C,5	1,6
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☐ Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

## \* Special categories of cited documents :

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*G\* document member of the same patent family

Date of the actual completion of the international search

8 June 2005

Date of mailing of the international search report

17/06/2005

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Morvan, D

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/JP2004/015179

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 6194741	B1	27-02-2001	NONE	
WO 0070654	A	23-11-2000	DE 19922187 A1	23-11-2000
			WO 0070654 A2	23-11-2000
			EP 1181712 A2	27-02-2002
			JP 2003500826 T	07-01-2003
			US 2002079535 A1	27-06-2002
WO 9952152	A	14-10-1999	JP 11297994 A	29-10-1999
			WO 9952152 A1	14-10-1999
US 2003160281	A1	28-08-2003	CN 1102274 A	03-05-1995
			US 6635906 B1	21-10-2003
			US 2005035406 A1	17-02-2005

# PATENT COOPERATION TREATY

From the  
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

## PCT

### WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY (PCT Rule 43bis.1)

Date of mailing  
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference  
see form PCT/ISA/220

**FOR FURTHER ACTION**  
See paragraph 2 below

International application No.  
PCT/JP2004/015179

International filing date (day/month/year)  
06.10.2004

Priority date (day/month/year)  
08.10.2003

International Patent Classification (IPC) or both national classification and IPC  
H01L29/78, H01L29/739, H01L29/06, H01L29/423, H01L21/336, H01L21/331

Applicant  
TOYOTA JIDOSHA KABUSHIKI KAISHA

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☒ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA"). However, this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of three months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA:



European Patent Office  
D-80298 Munich  
Tel. +49 89 2399 - 0 Tx: 523656 epmu d  
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Authorized Officer

Morvan, D

Telephone No. +49 89 2399-2258





**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**

International application No.  
PCT/JP2004/015179

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**Box No. I Basis of the opinion**

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1. With regard to the **language**, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.  
☐ This opinion has been established on the basis of a translation from the original language into the following language , which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).
2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
  - a. type of material:  
☐ a sequence listing  
☐ table(s) related to the sequence listing
  - b. format of material:  
☐ in written format  
☐ in computer readable form
  - c. time of filing/furnishing:  
☐ contained in the international application as filed.  
☐ filed together with the international application in computer readable form.  
☐ furnished subsequently to this Authority for the purposes of search.
3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**

International application No.  
PCT/JP2004/015179

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**Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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1. Statement

Novelty (N)	Yes: Claims	2-10,12,13
	No: Claims	1,11
Inventive step (IS)	Yes: Claims	2,7,12
	No: Claims	3-6,8-10,13
Industrial applicability (IA)	Yes: Claims	1-13
	No: Claims	

2. Citations and explanations

**see separate sheet**

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**Box No. VII Certain defects in the international application**

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The following defects in the form or contents of the international application have been noted:

**see separate sheet**

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**Box No. VIII Certain observations on the international application**

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The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**

**Regarding Section V:**

1. Reference is made to the following documents; the numbering will be adhered to in the rest of the procedure:  
  
D1 = US-B-6 194 741  
  
D2 = WO-A-00/70654  
  
D3 = WO-A-99/52152
2. Insofar as the present text can be understood (see item VIII in this respect), the subject-matter of independent claims 1 and 11 is not new in the sense of Rule 64(1)-(3) PCT, contrary to the requirements of Article 33(2) PCT:
  - 2.1 D1 (see in particular column 4, lines 49-60 and figure 6) discloses an insulated gate type semiconductor device having obviously all the features of the subject-matter of claim 1, see the body region 23, the drift region 22, the trench section 30, the floating region 32, the insulating layer 31 (being deposited oxide) and the gate electrode 34, the bottom of the trench section being arranged in the floating region and the top of the insulating layer being above the top of the floating region.  
Hence, the subject-matter of claim 1 lacks the required novelty.
  - 2.2 Furthermore, D1 (see column 2, line 36 - column 3, line 50 and figures 1-2) discloses a manufacturing method of an insulated gate type semiconductor device having obviously all the features of the subject-matter of independent claim 11, see the body region 23, the drift region 22, the trench section 30 and the gate electrode 34, the trench forming step carried out after body and drift formation, the impurity injecting (implantation) step into the trench bottom and the subsequent insulating material laying-up step, and the floating region thermal diffusion step carried out after impurity injection.  
Hence, the subject-matter of independent claim 11 also lacks the required novelty.

In this respect it is from now on moreover noted that the device shown in figure 6 of D1 is implicitly manufactured in accordance with the method generally disclosed with respect to the device shown in figures 1-2 of D1.

3. Furthermore, insofar as the present text can be understood (see item VIII in this respect), the subject-matter of dependent claims 3-6, 8-10 and 13 does not involve an inventive step in the sense of Rule 65(1)-(2) PCT, contrary to the requirements of Article 33(3) PCT:

- 3.1 The additional features of dependent claims 3 and 6 are merely matters of normal design procedure, see eg. D2, page 7, lines 7-18 and figure 3, and the skilled person would consider the inclusion of said features in the device known from D1 as constituting obvious design possibilities to increase the breakdown voltage of the device.

Furthermore, the additional features of dependent claims 4, 5, 8, 9 and 13 relate to straightforward changes in the subject-matter of dependent claims 3 (regarding claims 4-5 and 9), 6 (regarding claims 8 and 9) or in a manufacturing method corresponding to the subject-matter of claim 3 (regarding claim 13).

Therefore, the subject-matter of dependent claims 3-6, 8, 9 and 13 does not involve an inventive step.

- 3.2 Providing a termination region having a trench structure with floating regions similar to that of the cell region is a normal design option in the present technical field, see eg. D3, figure 4.

In particular, to simplify manufacturing, the skilled person would readily provide trenches extending into the floating regions in the termination region for a device such as that of D1 having already such trenches in the cell region.

Furthermore, in the finished device the terminal (termination) trench section without gate electrode would be filled with an insulating layer for passivation, as is well-known in the present technical field.

Hence, the subject-matter of dependent claim 10 does not involve an inventive step either.

**Regarding Section VII:**

1. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1 to D3 is not mentioned in the description, nor are these documents identified therein.
2. The features of the claims are not provided with reference signs placed in parentheses, contrary to the requirements of Rule 6.2(b) PCT.

**Regarding Section VIII:**

The present application does not meet the requirements of Article 6 PCT because claims 1-3, 6-8, 10, 11 and 13 are not clear:

1. The expression "corresponding to" used in claims 1-3, 6-8, 10 and 11 is vague and unclear and leaves the reader in doubt as to the meaning of the technical features to which it refers, thereby rendering the definition of the subject-matter of said claims unclear.
2. The wording of device claim 1 leaves a doubt as to the category of said claim since the term "deposited" used in the claim relates to a method of making the device (by deposition as compared with eg. oxidation) rather than imposing any clear restrictions on the device itself.
3. The wording of the last feature of claim 11 is inconsistent since impurity is not injected in the insulating material laying-up step.
4. It is not clear whether the peripheral region of the cell region mentioned in claim 13 is the region where the auxiliary trench section as defined in claim 3 and 8 is formed, or rather is the region where a terminal trench section as defined in claim 10 is formed.